Workshop:

“Mini-Grids for Resilient Energy Supply: the Community of San Rafael as Case Study”

University of Oldenburg

Transformative Research – Knowledge and Action for rural (local) energy transitions

Online lecture
27th Sep. 2023

Dr. phil. Willington Ortiz Orozco

What I actually want to convey (i)

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1. (Human sustainable) Development ...

- …is tightly related to the individual and collective freedom of being human! [see Sen 1998]
- Whatever your role in endeavours towards sustainable development is, take care of building and departing from a notion of development that integrates the valuations of all the actors involved in the process.

2. The role of science in the social-ecological transformation

- There is not something like “neutrality”. Science and its products (knowledge) are embedded in society. “Valid Knowledge” is power.
- Build your own position about the political context and implications of your research. Try to align your research-praxis accordingly [see Fals-Borda 2001]

What I actually wanted to convey (ii)

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3. Remember: energy is a <u>mean</u> for…

- Decentralised (renewable) energy solutions are a means for strengthening the livelihoods of rural populations *[… they are not an end in themselves]*

4. SDG7 is about fostering deep <u>social changes</u>

- It involves inducing profound changes at different levels of social structures

[… not just the installation of appropriate technology].

- … requires local leadership, i.e. activating the capacities of local actors for driving change *[… not only the intervention of (technical) experts]*

Agenda

- The Wuppertal Institute & the WISIONS Initiative
- What is development about?
- The role of science in achieving sustainable development
- Practical framework for local energy transitions

The Wuppertal Institute

Mission of the Wuppertal Institute

Research for a sustainable development

- The Wuppertal Institute undertakes research and develops models, strategies, and instruments for **transitions to a sustainable development** at local, national, and international level

- Sustainability research at the Wuppertal Institute focuses on the **resources, climate, and energy** related challenges and their relation to economy and society

- Special emphasis is put on analysing and stimulating innovations that decouple economic growth and wealth from natural resource use

Headquarters in Wuppertal

Berlin Office

Research Structure

Wuppertal Institut

Transformation Research

Research Units

- International Energy Transitions
- Sectors and Technologies
- Structural Change and Innovation
- Systems and Infrastructures

Division **Future Energy and Industry Systems**

Research Units

- Global Climate Governance
- Energy Policy
- Mobility and International Cooperation
- Mobility and Transport Policy
- Urban Transitions

Division **Energy, Transport and Climate Policy**

Management Board

President and Vice-President

Business Manager

Research Units

- Innovation Labs
- Production and Consumption Systems

Division **Sustainable Production and Consumption**

Research Units

- Digital Transformation
- Material Loops

Division **Circular Economy**

IET thematic focus

IET develops solution pathways for sustainable energy system and industrial transformation in developing regions.

Research focus 1

"The global energy transition begins with local solutions"

The first research focus identifies **success factors for sustainable energy systems in developing countries** and supports the implementation of holistic energy solutions at **the local level by means of detailed scientific analyses.**

Projects: Wisions, PeopleSuN, SESA

Research focus 2

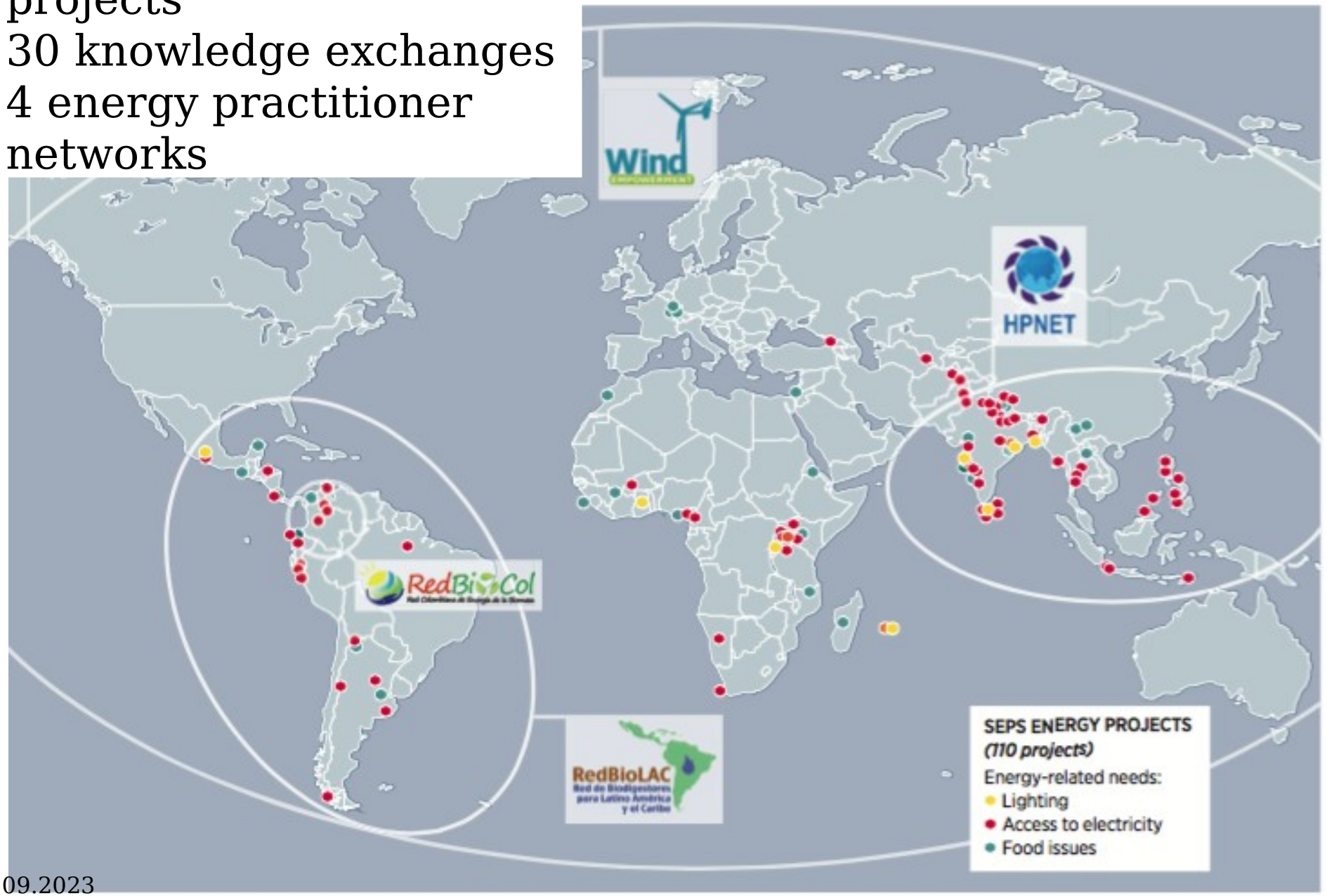
"The transformation to decarbonised energy and industrial systems opens up sustainable development opportunities"

In the second research focus, **energy, climate and sustainability strategies** are developed for individual **countries and sectors** and their implementation options are outlined.

Projects: hybit , **:** SophosM ; GreeEco EGY; IKI JET

WISIONS financial support activities

- 100 demonstration projects
- 30 knowledge exchanges
- 4 energy practitioner networks



Two Research Fields

Impact assessment and sustainability effects

- What does work? What doesn't?
- Why?
- Which effects on sustainable development?

Examples of publications:

- Terrapon-Pfaff J. et al. (2018): Productive use of energy – Pathway to development? … https://doi.org/10.1016/j.rser.2018.07.016
- Terrapon-Pfaff J., et al. (2014): A cross-sectional review: … http://dx.doi.org/10.1016/j.rser.2014.07.161
- Terrapon-Pfaff J.et al. (2014): How effective are small-scale energy interventions … DOI: 10.1016/j.apenergy.2014.05.032

Transformation processes from the bottom-up

- How do bottom-up initiatives pursue change of local socio-economic structures?
- (How) Do bottom-up/local initiatives contribute to broader social transformations?

Examples of publications:

- Ortiz W., et al. (2018): The diffusion of sustainable family farming practices …doi:10.1007/s11625-017-0493-6
- Ortiz W., et al. (2012): Introducing Modern Energy Services into Developing Countries…doi:10.3390/su4030341
- Ortiz W. (2019): Social change through diffusion of sustainability innovations from the bottom-up … https://nbn-resolving.org/urn:nbn:de:gbv:luen4-opus-145960

What is development about?

Sen‘s capability approach (ii)

Functionings: “… ability to do certain things and to achieve certain types of beings (such as being well nourished, being free from avoidable morbidity, being able to move about as desired, and so on)“

Freedom of choice (among functionings) = central to evaluate development

“A person's capability can be seen as the set of alternative functioning n-tuples any one of which the person can choose.”

The valuation Problem:

- Functionings may differ from one person to other (value heterogeneity)
- Change involved in development alter also the valuation of the people involved (value-endogenaity).

Amartya K. Sen (1988): The Concept of Development. In: Chenery H, Srinivasan TN Handbook of Development Economics. Amsterdam: North Holland, pp. 9-26

Development discourse as tool for domination

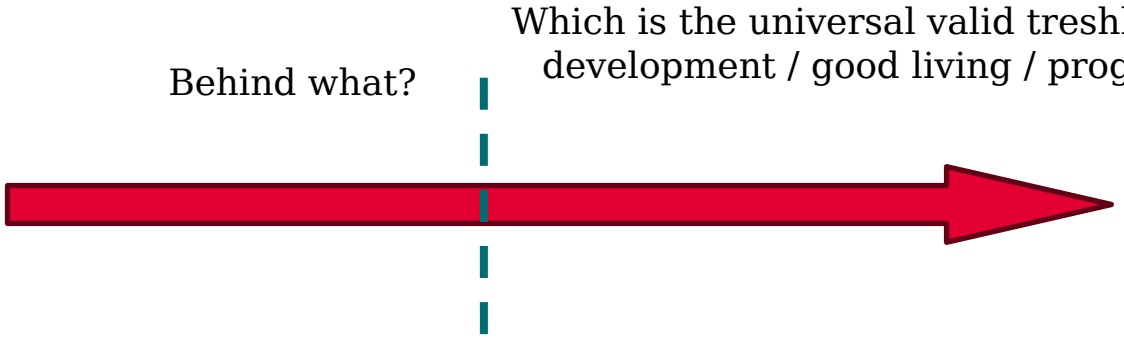
Deployment Mechanisms

- Intrinsic causality: underdevelopment derives from characteristics of the poor.
- Objectivist empiricism: “the Third World and its peoples exist “out there,” to be known through theories and intervened upon from the outside”
- Labelling: create client categories (“malnourished”, “small farmers”), which determine access to resources (“beneficiaries”, “target group”)
- Problems definitions reflect the kind of interventions that the development institutions operate

Arturo Escobar (1995). Encountering development: The making and unmaking of the Third World. Princeton, N.J: Princeton University Press.

How can the Agenda 2030 be interpreted?

- “We are resolved to free the human race from the tyranny of poverty and want and to heal and secure our planet… we pledge that **no one will be left behind**.”

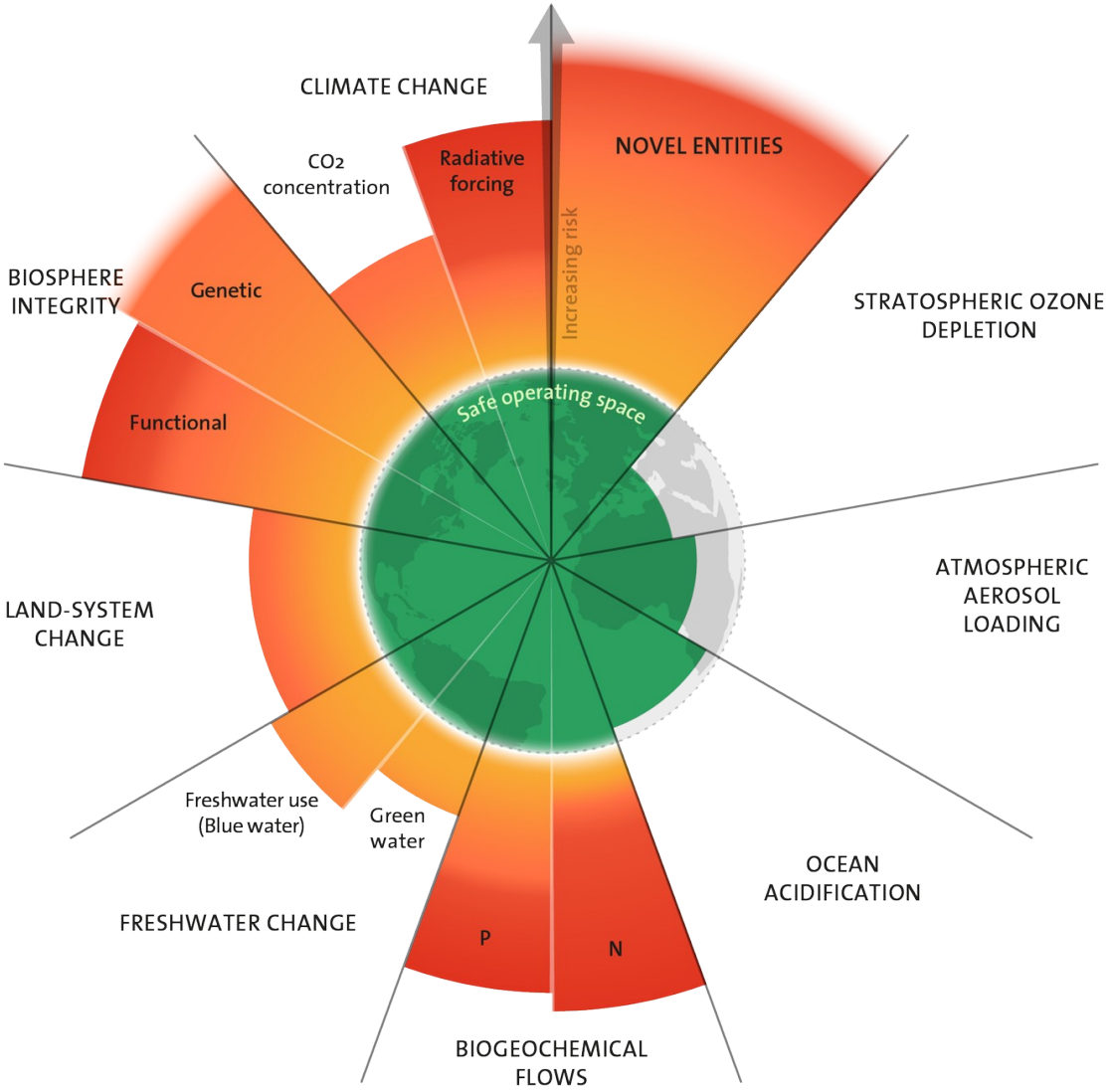


- “We are determined to end poverty and hunger … and to ensure that all human [and non-human] beings can **fulfil their potential in dignity and equality** and in a healthy environment.”

How can the SDGs be interpreted?

- Universal catalogue of functionings?
- Renewed representations of under-development?
- A quite and informal funeral to the ‘development myth’?
- Sustainable Survival Goals?

Why social-ecological transformation?



There is a fairly good understanding (and consensus) about the ecological challenges and the key variables for tracking them

Richardson et al (2023): Earth beyond six of nine planetary boundaries. In: Science Advances. DOI: 10.1126/sciadv.adh2458

Why social-ecological transformation?

Which are key control variables and their status?

- Globalisation
- Authoritarianism
- Dismiss of Democracy
- Increasing inequality
- Capitalism, Capital concentration
- Racisms, Imperialism, Colonialism
- Patriarchalism, androcentrism
- …?

What is sustainability about?

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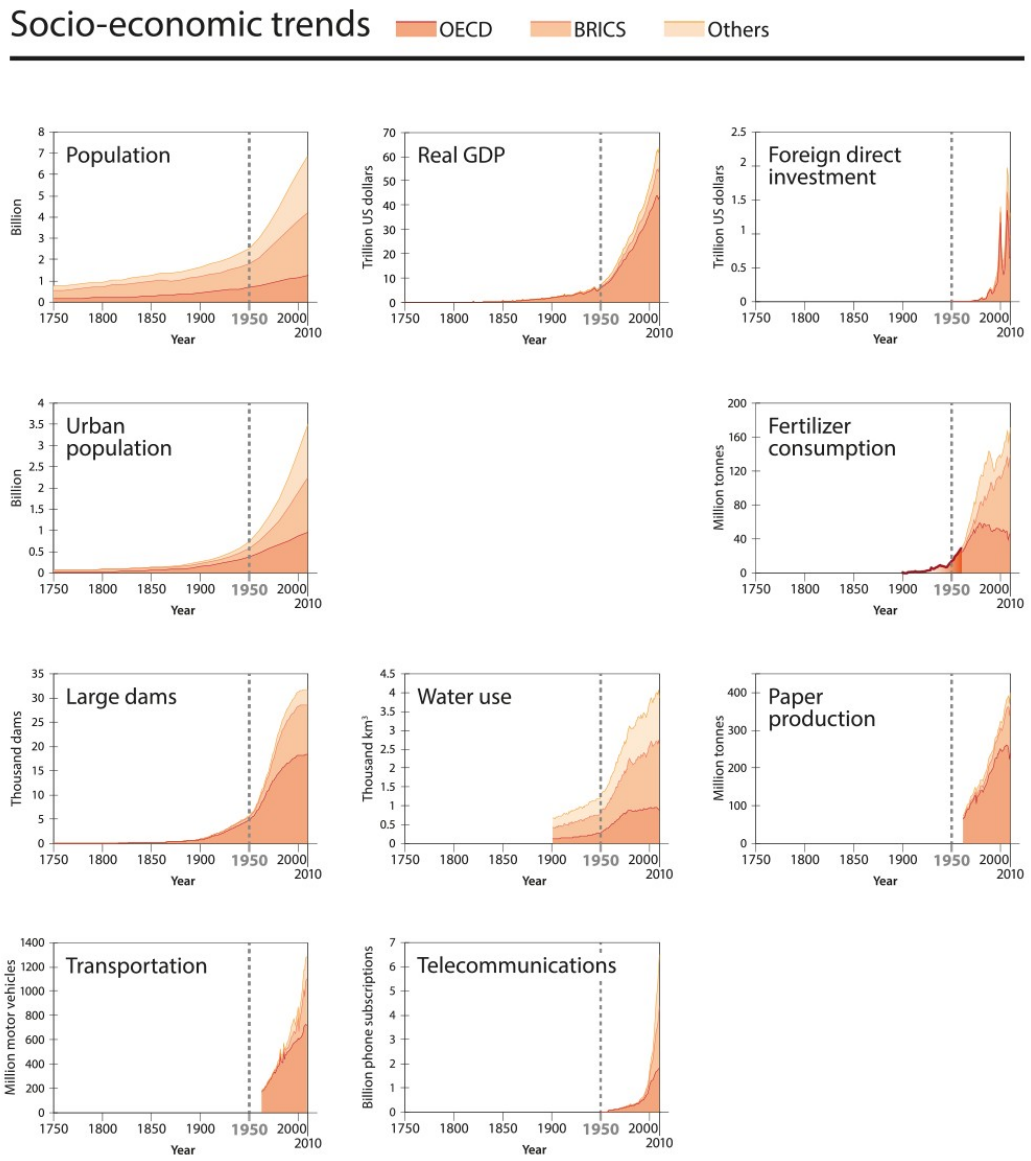
"… it is about **undeveloping**, about winding up the **imperial lifestyle** of the transnational middle classes."

Wolfgang Sachs, (2017): The Sustainable Development Goals and Laudato si': varieties of Post-Development?, Third World Quarterly, DOI: 10.1080/01436597.2017.1350822

Ulrich Brand and Markus Wissen (2017): "The Imperial Mode of Living" in: Spash, Clive (ed.): Routledge Handbook of Ecological Economics.



https://futureearth.org/2015/01/16/the-great-acceleration/

How can science contribute to solve this mess?

What kind of research is required?

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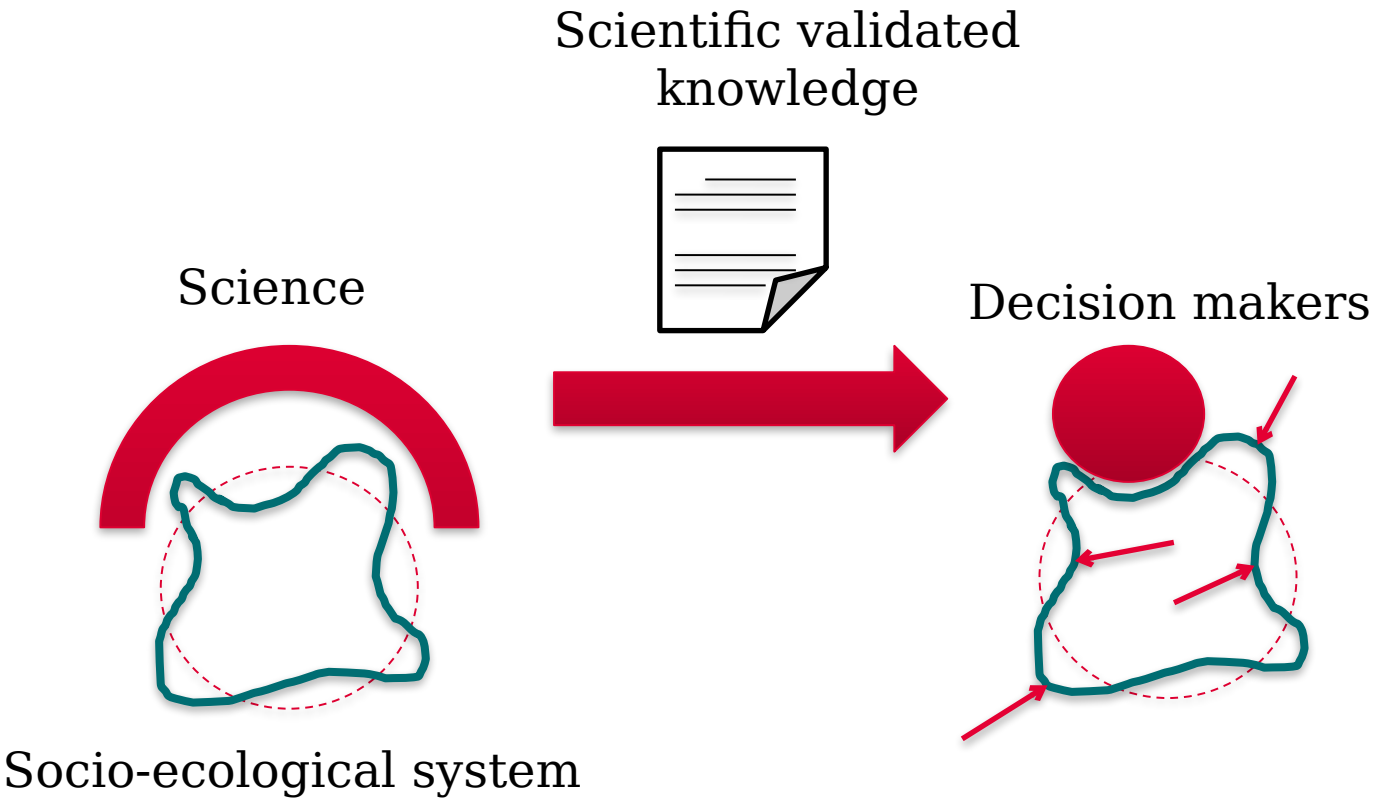
“… innovation is seen as the way out of the present syndrome of overpopulation, … resource shortage, omnipresent pollution, etc., even though two centuries of unbridled innovation are responsible for bringing about … the current sustainability challenge[s]. ”

Sander van der Leeuw: “The archaeology of Innovation: lessons for our times”

The societal role of Science (oversimplified!)



Complex (sustainability) problems
-> call for new modes of research

- **Focus on societally relevant problems**

- **Enable mutual learning processes …**
  - among different disciplines …
  - … and with actors outside ‘science’

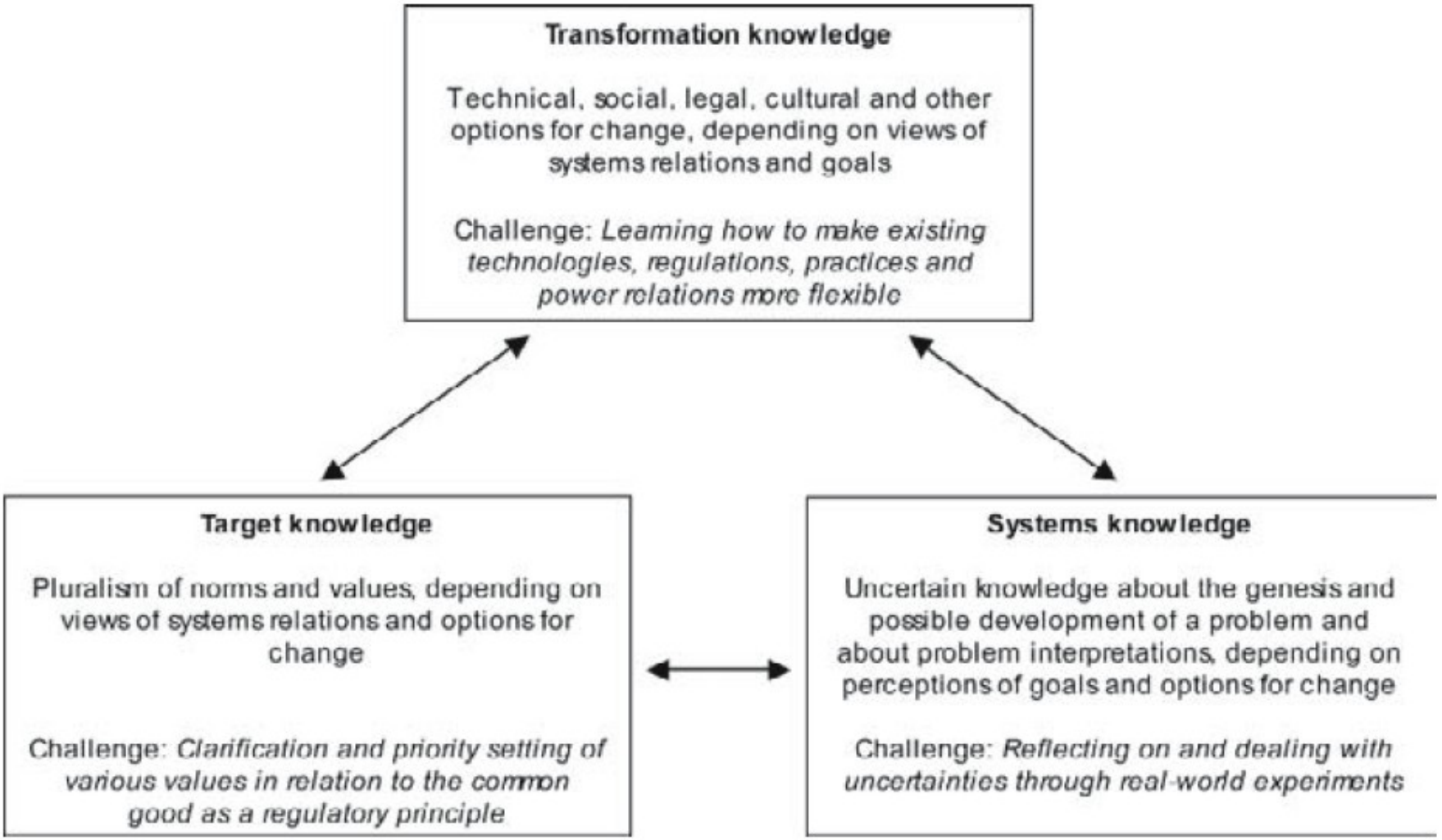
- **Generate socially and culturally robust knowledge**
  - Knowledge that can be understood, discussed and processed by all parties involved,
  - … incorporates ambiguity, complexity, and contradictions as fundamental features
  - … serves societal transformation

    [Ulli Vilsmaier, et al. 2017: Research In-between: The Constitutive Role of Cultural Differences in Transdisciplinarity. Transdisciplinary Journal of Engineering & Science, 8, pp. 169-179]

- **Develop methodological approach for decision under wide range of uncertainties**

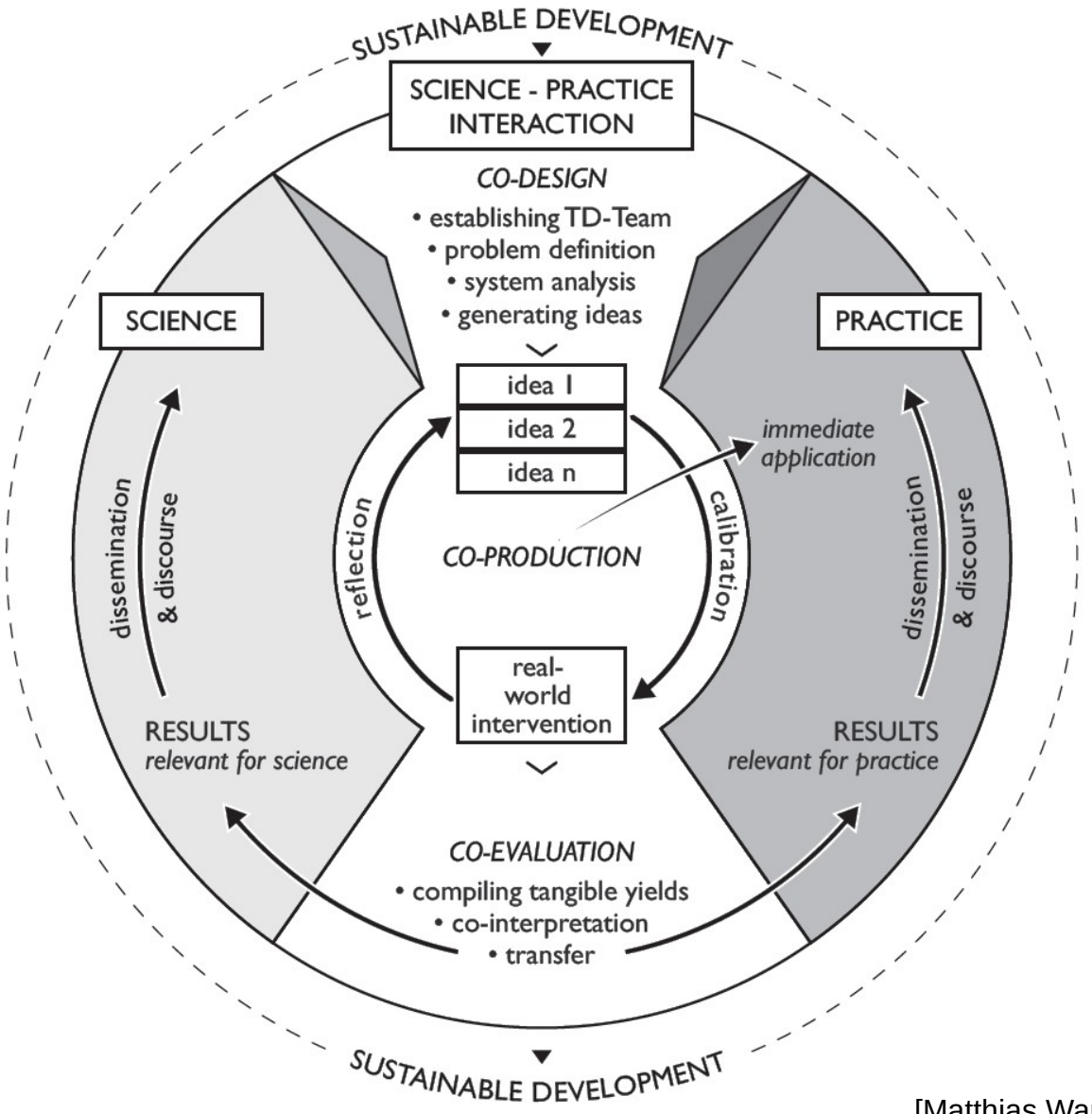
- **Entangle scientific exploration and practical application**

Transdisciplinarity as integration of “knowledge types”



Hirsch Hadorn et al., 2008: Handbook of Transdisciplinary Research

Cyclical model of transdisciplinary transformative research process



[Matthias Wanner et al. 2018: "Towards a Cyclical Concept of Real-World Laboratories"

“…if we could discover a way to bring about a convergence between popular thought and academic science, we could gain both a more complete and more applicable knowledge - especially by and for the underprivileged classes which were in need of scientific support. This convergence we found both possible and convenient.”

Orlando Fals Borda (2001): “Participatory (Action) Research in Social Theory: Origins and Challenges”, in: Handbook of Action Research, eds: Reason P. and Bradbury H., Sage Publications

How does energy (access) contribute to sustainable development of rural communities?

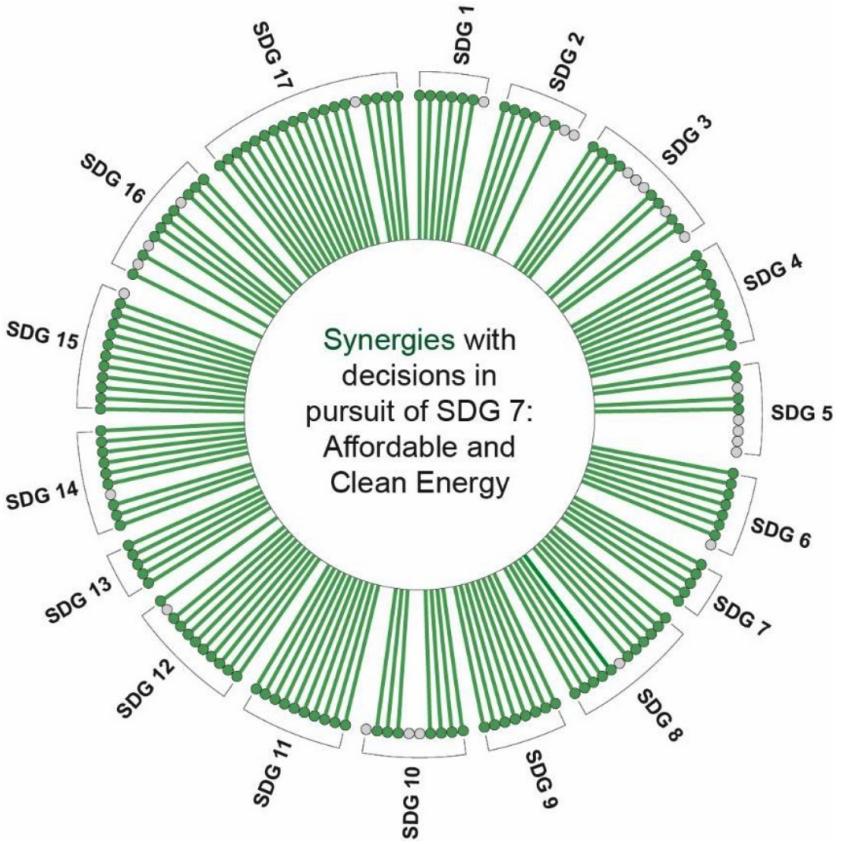
“Universal access to affordable, reliable, and modern **energy** services … is a **prerequisite** and a **catalyst** for improving the living and working conditions of all the world's people, especially the poorest and most vulnerable populations…”

UN 2021: “THEME REPORT ON ENERGY ACCESS: TOWARDS THE ACHIEVEMENT OF SDG 7 AND NET-ZERO EMISSIONS”, Theme Report in support of the High-level Dialogue on Energy: https://www.un.org/sites/un2.un.org/files/2021/09/2021-twg_1-091021.pdf

(Yes, but – just as catalysts in chemical reactions – the presence of other factors relevant for human development are needed in order to effectively trigger transformation!)

https://www.wisions.net/wp-content/uploads/2022/11/WISIONS-Takeaways_Seminar-1.pdf

Synergies between SDG7 and other SDG Targets



143 SYNERGIES

WELLFARE AND WELLBEING	Ending **poverty** & providing access to **healthcare, education, water and sanitation**
INFRASTRUCTURES	**Energy infrastructures** for: ○ **Food & Water** systems ○ **Medical** facilities ○ Sustainable **cities**
ENVIRONMENT	**Renewable and efficient energy** will be needed to achieve environmental targets

Source: Fuso Nerini , F., Tomei, J., To, L.S., et al. (2018), Mapping synergies and trade offs between Energy and the Sustainable Development Goals ', Nature Energy , 3, 10 15

Synergies between SDG7 and other SDG Targets

1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, (...) , appropriate new technology (...)

2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers (...), including through secure and equal access to land, other productive resources and inputs, (...) and opportunities for value addition and non-farm employment

3.8 Achieve universal health coverage, including (...) access to quality essential health-care services and access to (...) essential medicines and vaccines for all

3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination

4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills ...

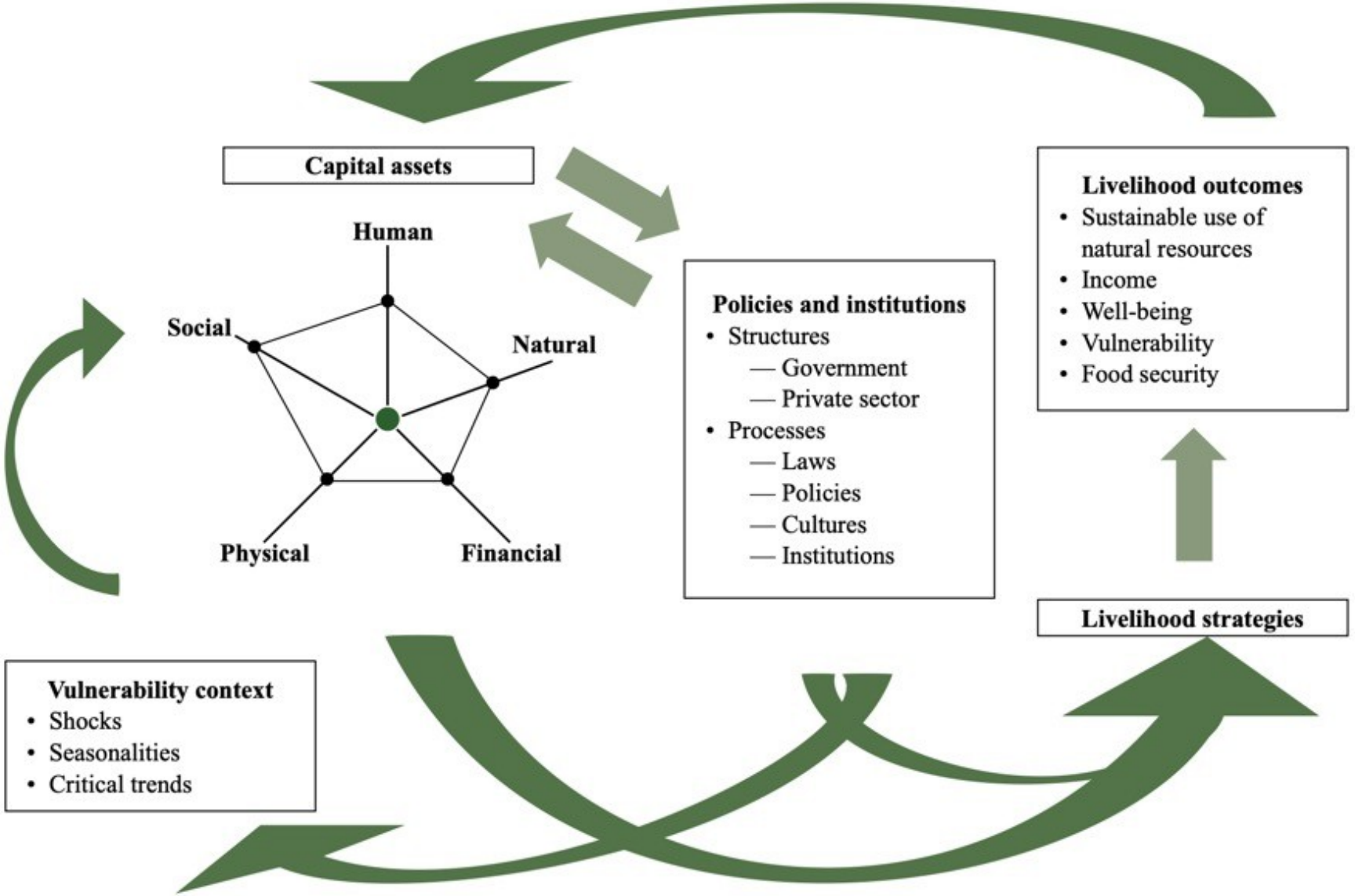
5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life

6.3 By 2030 (...) halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater (...)

Acconting for those „other factors“ of sustainable development

Sustainable Livelihoods Approach



Serrat, O. (2010). The sustainable livelihoods approach. Washington, DC: Asian Development Bank.

A practical framework for local energy transitions...

... that strengthen resilience of rural livelihoods

General (empirical) observations (1)

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From community-based energy projects…

… it is not only technical issues that pose the greatest challenge

… socio-cultural and economic barriers are often more difficult to overcome

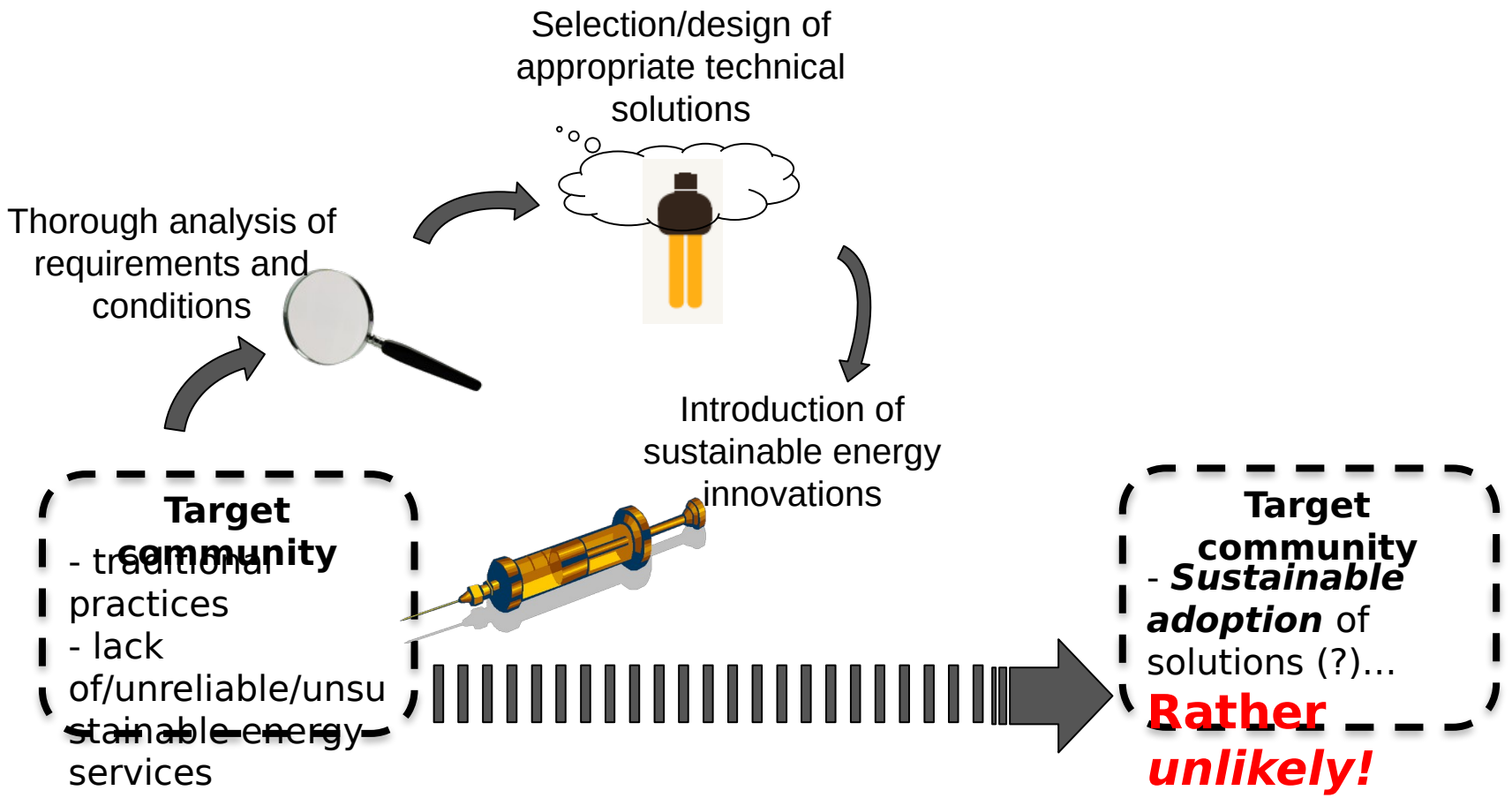
Terrapon-Pfaff et al (2018): Productive use of energy – Pathway to development? Reviewing the outcomes and impacts of small-scale energy projects in the global south. https://doi.org/10.1016/j.rser.2018.07.016

Terrapon-Pfaff et al (2018): Impact pathways of small-scale energy projects in the global south – Findings from a systematic evaluation. https://doi.org/10.1016/j.rser.2018.06.045

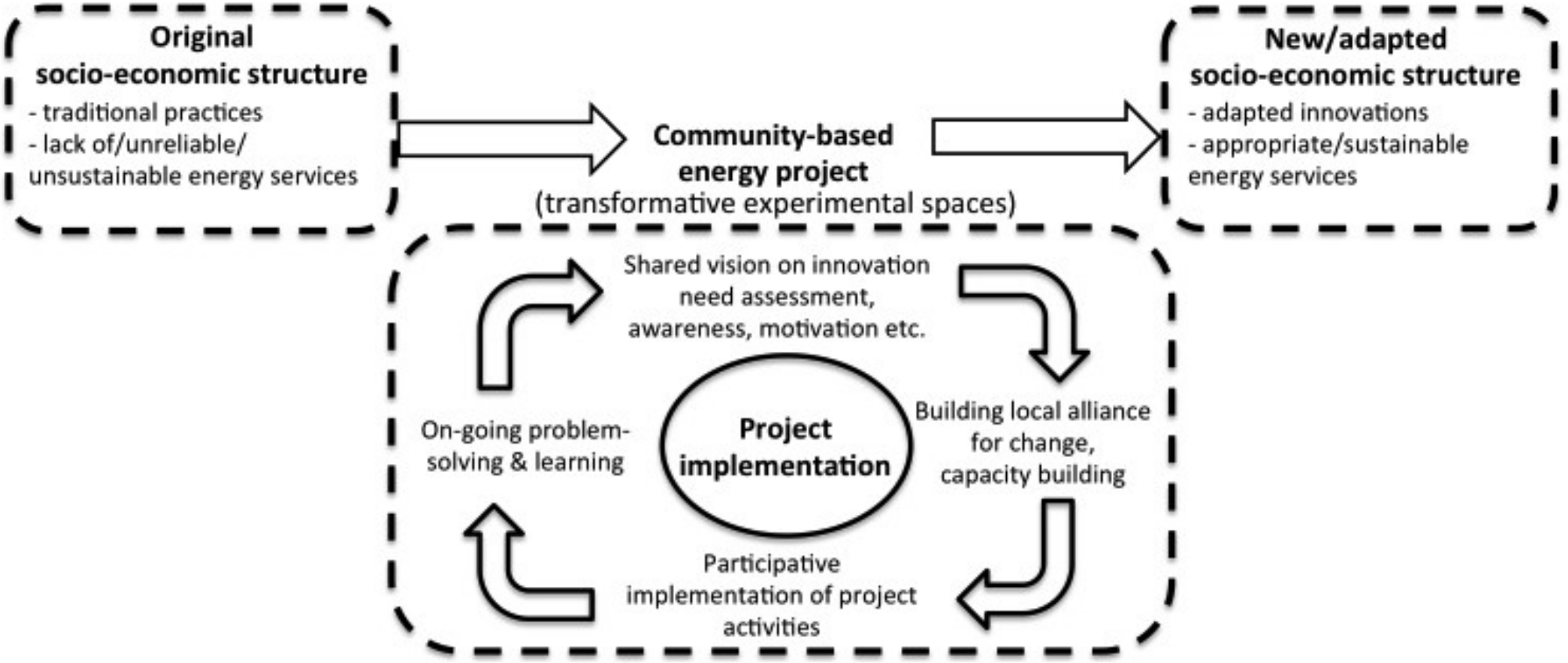
Ortiz et al. (2017): Understanding the diffusion of domestic biogas technologies. Systematic conceptualisation of existing evidence from developing and emerging countries. http://dx.doi.org/10.1016/j.rser.2016.11.090

General (empirical) observations (2)

Selecting/designing appropriate technical solutions is a necessary but not sufficient condition for ensuring sustainability of project activities.



Energy interventions as socio-technical evolutionary process at local levels



Ortiz et al 2012: Introducing Modern Energy Services into Developing Countries: The Role of Local Community Socio-Economic Structures. doi:10.3390/su4030341

Lessons along the project cycle

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01 Conception

- Identify **capacities, resources and existing structures**
- Determine where sustainable energy can have the greatest **impact**
- Build **partnerships** with stakeholders

02 Design

- Development of a **management model t**o ensure sustainable operation of the technology after completion of the project
- Involvement of the local population in the planning phase (creating a sense of **ownership**)
- Analysis and inclusion of potential **future demand developments**
- Application of technologies that have already been used under similar conditions

03 Implementation

- **Flexibility** to respond to changes of different kinds
- Transparent **communication**
- Involvement of **existing organisational structures** of local communities
- **Shaping management model** (i.e. the structure of actors, roles and responsibilities)
- **Monitoring** and reflection of project activities

04 Operation and Maintenance

- Activities to **build local capacities** for the **management, operation and basic maintenance** of the system
- Ensuring that **after-sales services** for all the technical components

05 Benefits form energy access

- **Facilitating investment** in additional equipment and other physical infrastructure
- Improve (or promote new) **productive skills**
- Create **access and linkages to markets**
- Create linkage **and integrating expertise beyond the energy sector** (e.g. health, agriculture, education, handicrafts and trade)

06 End of life

- Supporting **recycling systems**
- Promoting the application of **circularity by design**

https://www.wisions.net/wisions-lessons-along-the-project-cycle/

Five key dimensions in community-based projects for energy and development

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- **Defining the ‘Target Need’**
  - Valuations & motivations
  - Building a baseline
  - Setting the targets
- **Technical feasibility**
  - Resource availability
  - Technology adequacy
  - Availability of technical expertise
- **Environmental impacts**
  - Construction/installation
  - Operation
  - End of life
- **Economic feasibility**
  - Ensuring sustainable operation (micro-economics single actors)
  - Up-scaling potential (financial performance)
- **Management model**
  - Distribution of roles, duties and rights
  - Check for existing organisational structures
  - Address this issue before starting implementation!

Five dimensions in community-based projects for energy and development

- **Defining the ‘Target Needs’**
- Technical feasibility
- Environmental impacts
- Economic feasibility
- Management model

Whether changing common practices is desirable, new solutions are beneficial and are the effort worth (or not) imply subjective valuations, which often differs from one actor to the other.

Therefore, involvement of local actors as early as by the formulation of project's core idea can reduce the risk of disappointments and failures

- Is there actually a need for more/better energy services?
- Who perceives that as a need?

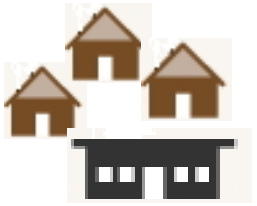
- Is there motivation to work for finding new solutions to that need?
- Who is motivated?
- Or, can motivation be (easily) stimulated?

Defining the need

Example “Access to Electricity”

Which scheme?

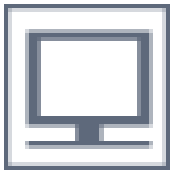
Single household 

Village 

Which services?

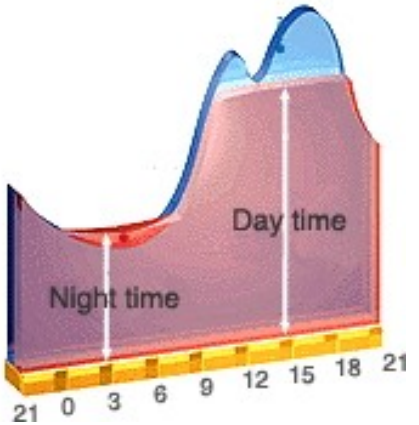
Basic services

Domestic appliances



Public services, productive uses, etc.

Projected power demand: Current ***and expected*** services



Defining the need

Example “Food processing”

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Which services?

Cooking
Baking

Drying

Refrigerating

Milling
Oil pressing

Assessing the current energy situation of end users is helpful. At least for two aims:

- Translating needs in technical and economic parameters:
  - [batteries/month]; [Wh/day/HH]; [kg Wood/day]; [m^3biogas/day]; etc…
  - [$/day]; [$/month]; [$/kWh]; etc…
- Monitoring/Evaluation: Assessing the actual impact of the initiative.

Example “Access to electricity”

Peru, Cajamarca, ‘El Alumbre’.
33 HH + School + Health centre
Main e. services:
lighting, radios
Main e. carriers:
Candles 100% of HH
Dry batteries 100% of HH
Kerosene 17% of HH
Average e. expenditures:
US$$_{2008}$ 5.5/month

Example “Energy for Cooking”

India, Karnataka, ‘Chikkana Devara Hattti’.
47 HH.
Main e. carriers:
twigs, crop residues
mainly own collection
Average e. consumption:
1400 kg Biomass/year/HH
average HH = 5.6 persons

Rather a complex task that requires finding a balance between:

- expectations from involved actors (i.e. end users, local authorities, project implementers, sponsors, etc…) and
- technical and economic limitations

!Exaggerated expectations are as harmful for project implementation as loosing users' support because of underestimated energy demand/supply

Five dimensions in community-based projects for energy and development

- Defining the ‘Target Need’
  - Perceptions & motivations
  - Building a baseline
  - Setting the targets
- **Technical feasibility**
- Environmental impacts
- Economic feasibility
- Management model

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Resource Availability

- Which energy resources are locally available?
- Are there enough data about them?
    - Data series of sun radiation, wind speeds, water flows, biomass productivity
    - ! Seasonality

Technology adequacy

- Has the technology been tested under the project site environmental and social conditions? Or similar conditions?
- Are supply of spare parts, maintenance and other technical services accessible?

Availability of technical expertise

Unlike the other two points, this aspect can (and should) be directly influenced by community-based projects. It entails two objectives:

- Expertise for project implementation.
- Expertise for securing sustainable operation after project conclusion.

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Biogas:

- Free grazing practices -> reduced amount of manure
- If Biogas-to-Power: lack of commercial "robust" gas generator sets of low power rates (<1kW)

Small Wind:

- Good wind data for specific sites are rather difficult to obtain.
- Although commercial turbines are available, data on long-term performance (e.g. reliability, maintenance costs) are still scarce

PV Solar Home Systems:

- Some programs have failed to establish channels between end users and providers: Guarantees, batteries, repair services.

Solar cookers:

- Cooking outdoors.
- Usual time for warm meals not during sunny hours.
- Can not be used as stand-alone solution.

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For Implementation

- Try to identify national/regional available expertise: Currently, organisations with some (or even long) experience in renewable energies can be found almost in any Country.
- Do not underestimate the complexity of any technology: Even the most ‘simple’ technology requires some grade of expertise in order to be designed, built, installed and operated correctly!

! Risk of technical failures can be particularly costly for end-users

Building local technical capacities

- Trainings: users, technicians, managers, authorities…
- Didactic Materials, manuals, posters …
- Appropriate tools.
- Channels to external technical advice.

Five dimensions in community-based projects for energy and development

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- **Environmental impacts**
- Economic feasibility
- Management model

Environmental Impact

Three main phases

Production Phase (construction and installation):

Materials, energy, land use, civil works, water works ...

Operation

Resource consumption, noise, emissions…

End of life

Recycling options, appropriate disposal systems,

! Using renewable energy resources does not necessarily translate into environmental friendly solutions

Local conditions, features of the technology as well as practical use can influence the overall environmental performance.

Five dimensions in community-based projects for energy and development

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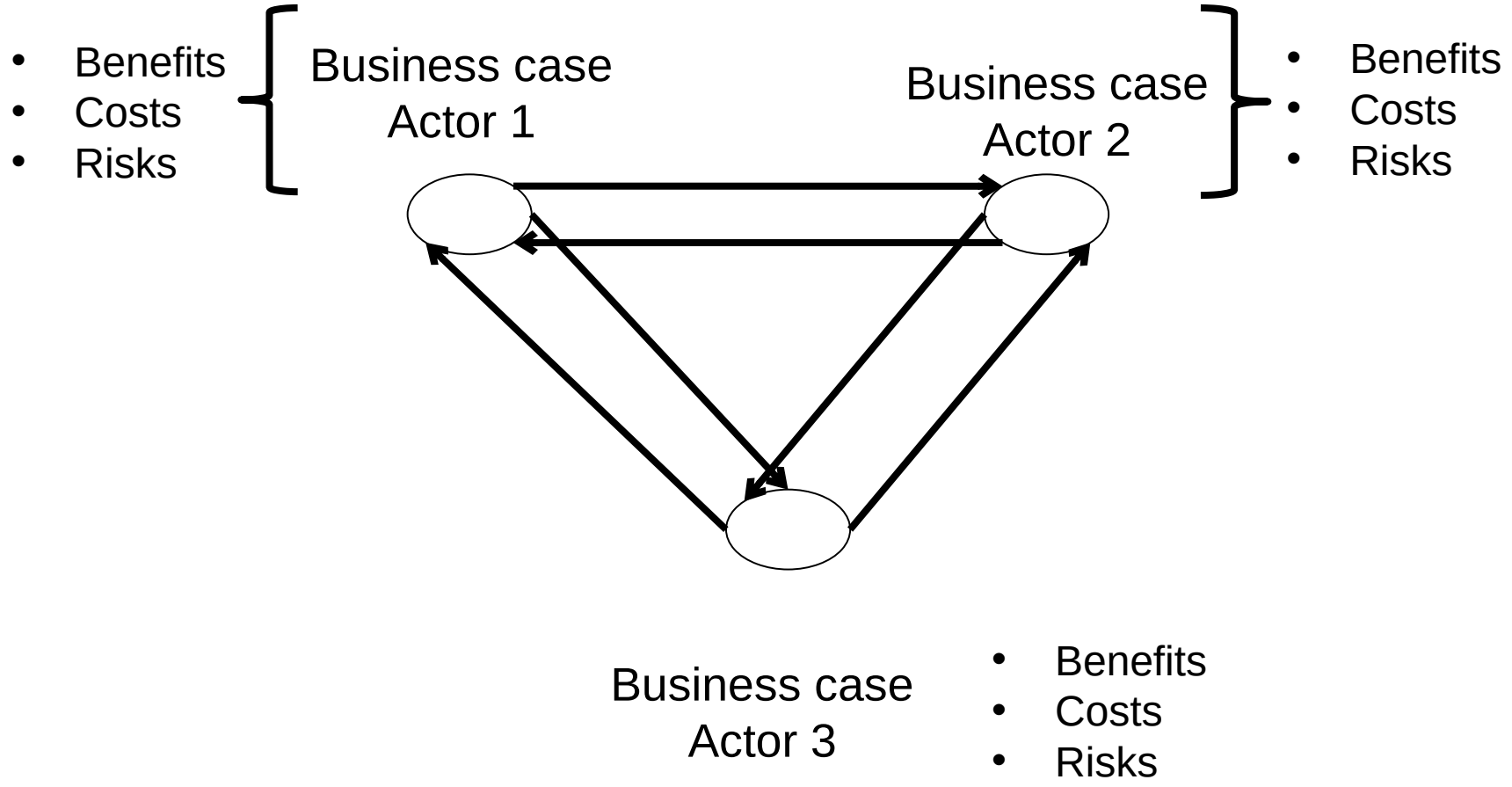
Economic feasibility

1. Ensuring sustainable operation



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Microeconomic impacts on project actors

as Consumers:

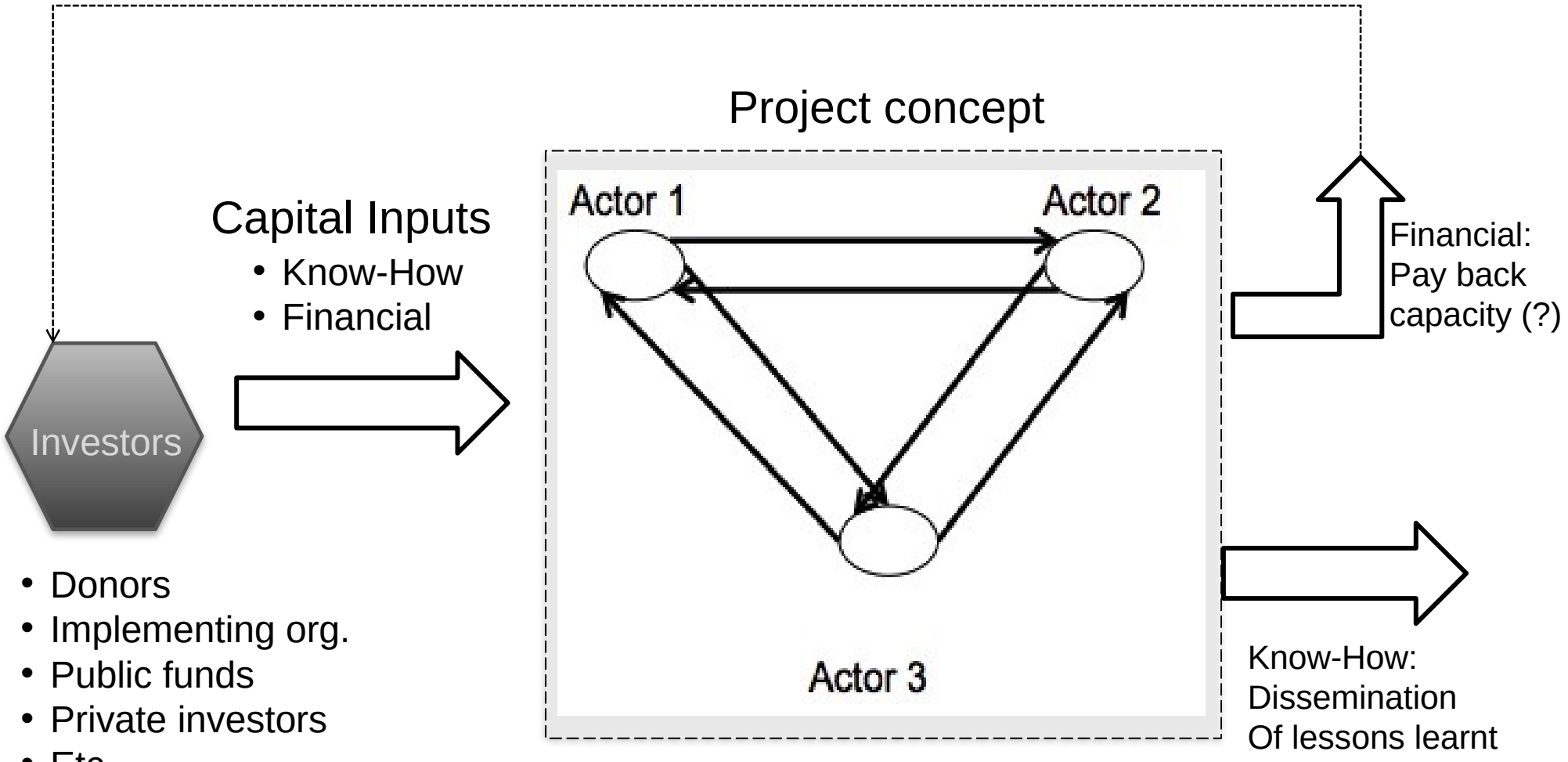
- **Shifting to higher level of Utility by unchanged budget constraints**
  - Access to (energy) services of higher quality (qualitative change)
  - Increasing consumption of (energy) services (quantitative change)
  - Freeing resources for rising and/or diversifying consumption (substitution/income effects)

as Producers:

- **Reducing costs and/or rising output and/or productivity**
  - Reducing energy costs of production
  - Scaling up existing processes (because higher supply of energy services)
  - Adopting new processes -> Offering new products/services

Economic feasibility

2. Up-scaling potential



Five dimensions in community-based projects for energy and development

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  - Operation
  - End of life
- Economic feasibility
  - Ensuring sustainable operation (micro-economics single actors)
  - Replication/up-scaling potential (financial performance)
- **Management model**

Management model

- How to distribute responsibilities among actors?,
- How to regulate interactions? (e.g. rights, duties, penalties)…

… so that the implemented solutions remain functioning once project implementation phase has concluded

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How to distribute responsibilities among actors?:

- Supply of inputs
- Ownership of equipment/infrastructure
- O&M of physical capital
- After sale services
- Payments for services
- Collection of fees
- Accounting
- Supervising (O&M, Accounting, etc.)
- Etc…

How to regulate interactions? (e.g. rights, duties, penalties):

- Existent institutional structures (e.g. Cooperatives, committees, etc.)
- Contracts
- Existent statutes/rules
- Tariff scheme
- Unspoken regulations
- Etc…

Distribution of roles should emerge from and/or be adoptable by local socio-economic structures

!! Establishing sustainable management systems requires:

- Knowledge on local realities (social, cultural, economic, political, etc.)
- Skills/experience in building consensus
- Transparent communication channels to local actors

!! Existing institutional structures (committees, associations, extension programs, etc.) might facilitate the process.

!! Building agreement on the management system should be part of the first stages of the project. At best already during project formulation, at the latest before the installation of physical systems.

Five key dimensions in community-based projects for energy and development

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- **Defining the ‘Target Need’**
  - Valuations & motivations
  - Building a baseline
  - Setting the targets
- **Technical feasibility**
  - Resource availability
  - Technology adequacy
  - Availability of technical expertise
- **Environmental impacts**
  - Construction/installation
  - Operation
  - End of life
- **Economic feasibility**
  - Ensuring sustainable operation (micro-economics single actors)
  - Up-scaling potential (financial performance)
- **Management model**
  - Distribution of roles, duties and rights
  - Check for existing organisational structures
  - Address this issue before starting implementation!

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WISIONS of sustainability

Thank you very much for your attention !

www.wisions.net

The Innovation Lab approach

- Energy and Agroecology solutions in Colombia

Overarching goal in Colombia

Catalyse **change in the provision system** of

renewable energy and **agroecological solutions** in Colombia

so that they become

increasingly accessible and applied

to effectively **strengthen the livelihoods of farming families**

Rural ways of living

"Agriculturas campesinas, familiares y comunitarias"

Focus on family farming systems with main commercial crops in…:

- **Cocoa**

- **Coffee**

Renewable Energy and Agroecological solutions

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Renewable energy

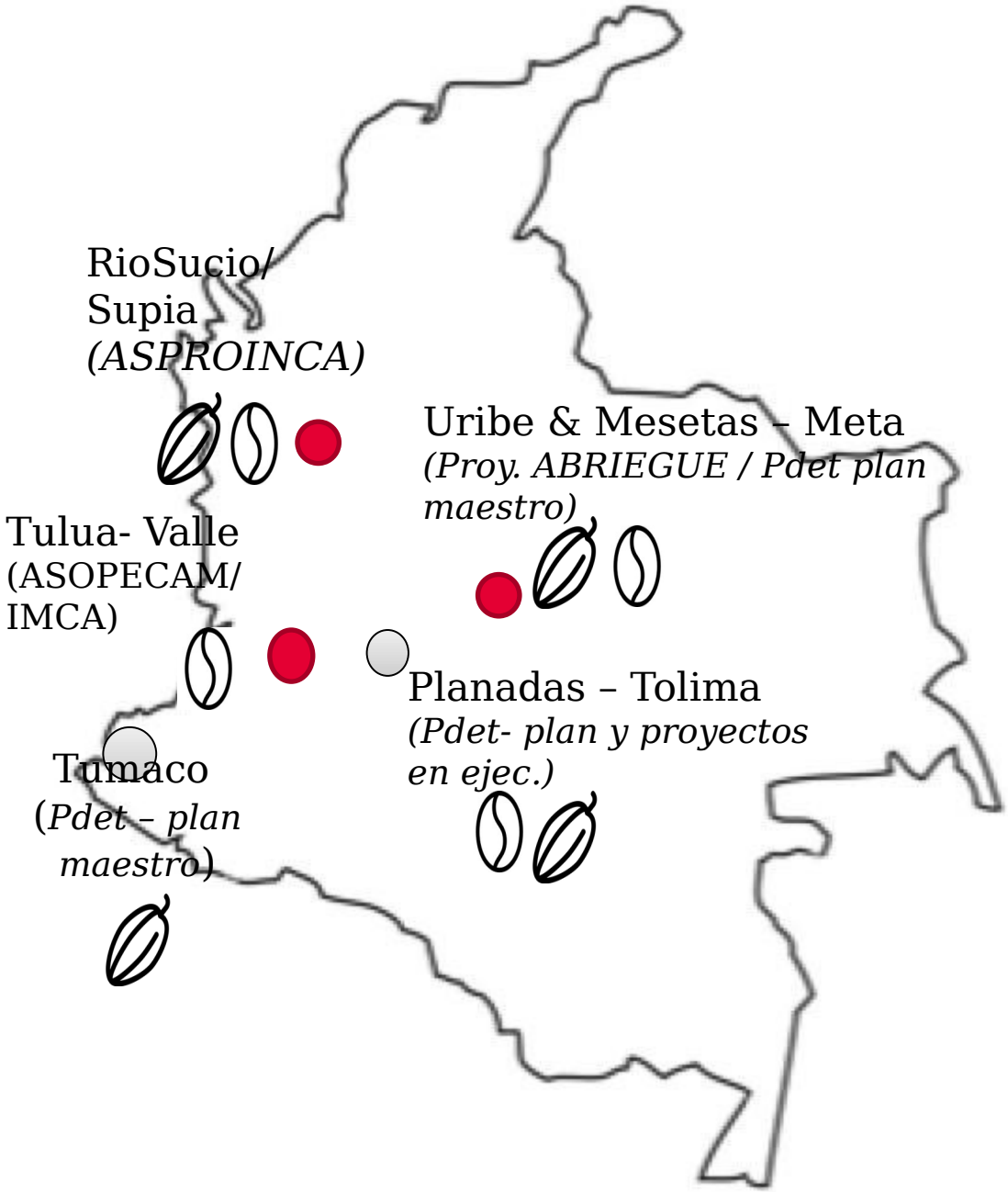
- Integration of Biodigesters in production systems
- Biogas-powered appliances (water heater, milk chillier, dryers, etc.)
- Solar pumping
- Solar dryers
- Solar PV powered appliances (electric fences, chilling rooms, mills, etc.)

Agroecology

- Silvopastoral systems
- Multi-cropping
- Diversified production systems
- Application of biodigesters effluents
- Integration of animal breading

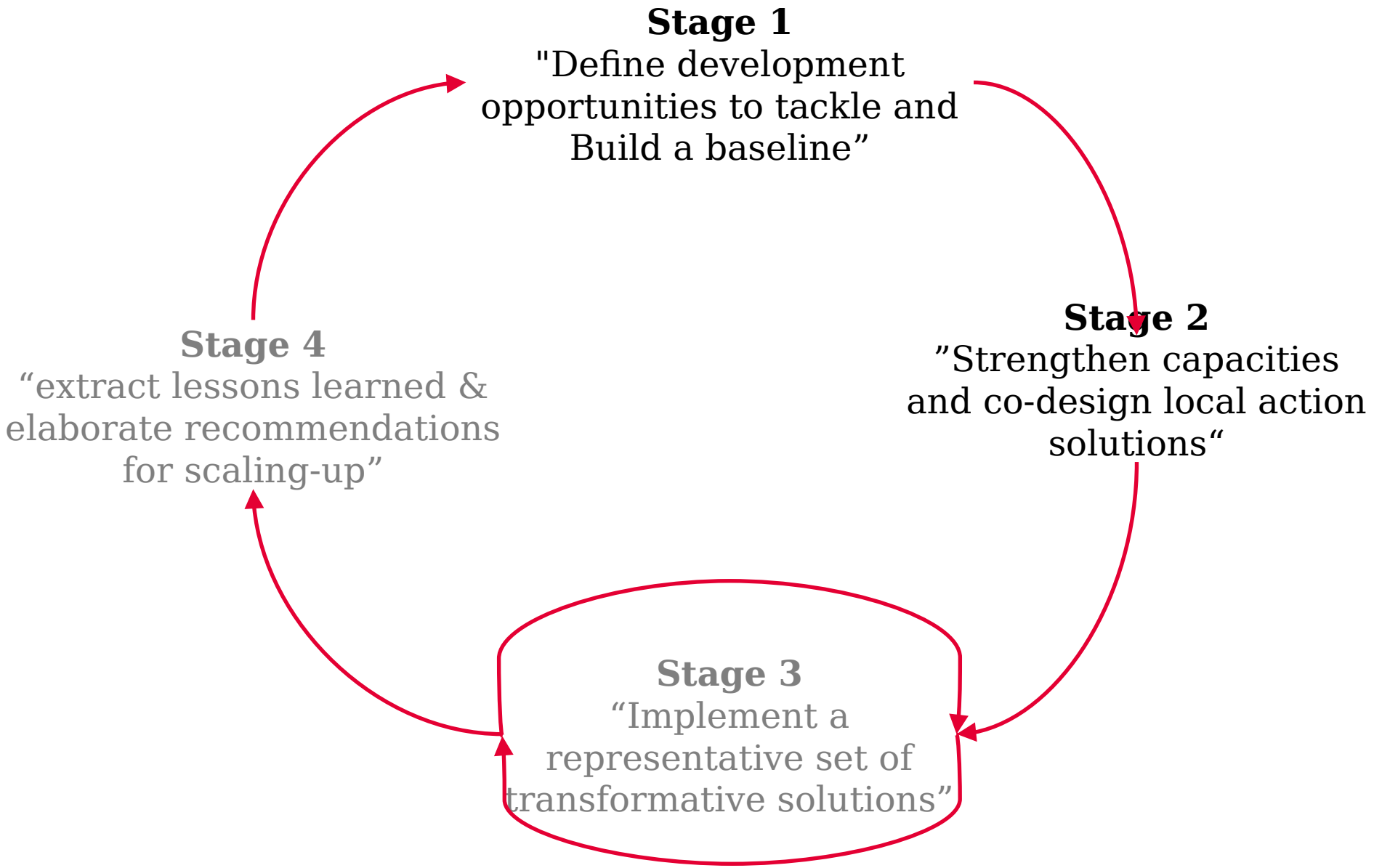
Direct involvement of local actors

- 8+ farmers Associations
- 4+ Municipalities
- 4+ Local solution suppliers
- 2+ Local research groups
- 2+ National programs

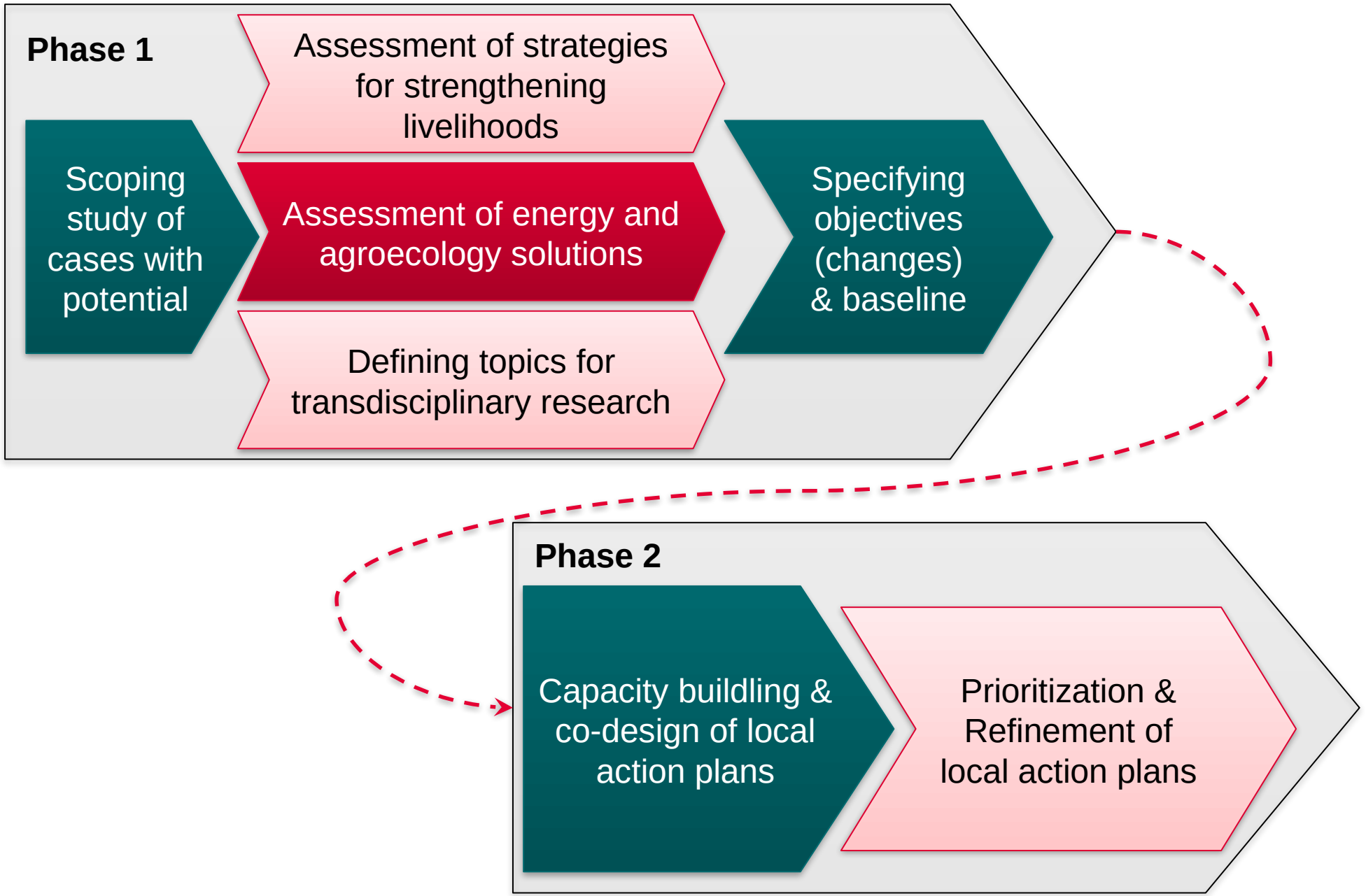


Wuppertal Institute's "Innovation Lab"

Central objective of each stage



Work packages of phase 1 and 2



Possible Research Topics within the frame of the Innovation Lab Colombia

- Systematic analysis of energy and agroecological practices that are currently applied by family farmers in Colombia
- System perspective on the value chains of coffee and/or cocoa in order to identify potentials for applying RE solutions
- Assessment of commercially available appliances with application in the coffee and/or cocoa processing.